STUDIES AND RESEARCHES CONCERNING THE DETERMINATION OF THERMAL TREATMENT OF THE ADAMIT TYPE HYPEREUTECTOIDE STEEL, ON CAST SAMPLES

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ABSTRACT

In this paper are presented lab experiments done on the purpose of determination of the thermal treatment technology (with the purpose of obtaining some corresponding hardness and their use in the production practice) and mechanical characteristics of the hypereutectoid steel, Adamite type, intended for casting the mill rolls. Samples have been taken out of three charges, out of which four rolls have been cast at metallurgical company. The test assays to determine the characteristics of the material have been done at the Engineering Faculty of Hunedoara.
Diagrams of thermal treatment applied to the mill rolls of Adamit type steel and cast sampled are presented, as well as the hardness values registered. The application of thermal treatments in the case of the mill rolls cast of hypereutectoid steel has a multiple character, respectively:

- eliminate the internal tensions which have very high values;
- decrease the hardness obtained at casting (370…400HB), till the values between the interval 280…300 HB, in view to increase the processing by splinting;
- correct the primary structure by destroying the cementite network, increase of the pearlite grains and its fineness in order to assure the imposed mechanical properties and especially the growth of the rolls face (not only in the superficial stratum but also in depth) at values of 380…420 HB.

Key words: mill rolls, thermal treatment, hypereutectoid steel, Adamit

1. INTRODUCTION

The Adamite type steels, called in the speciality literature "wild cast irons", have 1,8…2,2% carbon and they are alloyed with Cr, Ni, Mo. As material, the Adamite type steel is situated, from the point of view of the chemical composition in the field of hypereutectoide steels alloyed with Cr, Ni, Mo, so that we have to apply on it operations of heat treatment. With the emergence of the punctiformal graphite as an effect of the heat treatment of annealing, structurally it has angle of crossing with the cast irons, too [1, 2, 3, 4].
Thus, in order to obtain the characteristics of the hardness and the wanted microstructure, to the mill rolls of Adamit Type steel are applied two thermal treatments, primary and secondary, whose diagrams are presented in fig. 1 [5, 6].

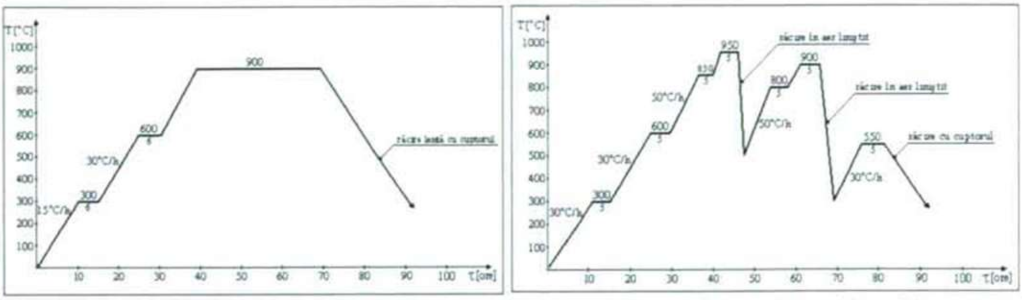


Figure 1. The thermal treatment applied to the mill rolls of Adamit type steel: a - primary thermal treatment; b - secondary thermal treatment

After the analyses done in the industrial practice we establish the following [5, 8]:

- in raw casting state, the mill rolls Adamit type have a high hardness (392…399HB) and therefore, they are subdued to a preliminary thermal treatment of softening, after which the hardness is decreased to 260…285 HB, so that they can be subdued to the mechanic chip removing process;
- After the mechanic process, the rolls are applied a secondary thermal treatment (steeling), after which the hardness increases at values at 380…440 HB on table's' face and 290…310 HB on necks, hardness that assure a good behavior in exploitation.

2. EXPERIMENTAL RESULTS

One very important aspect connected to the behaviour in exploitation of the mill rolls is the knowledge of the materials characteristics of which they are made. A very important problem connected to the mill rolls cast of hipereutectoid steel Adamit Type (OTA3) is that of establishing a corresponding thermal treatment which provides the possibility of processing, as well as the obtaining of some final hardness at high values, able to carry out a good wear strength [6].
In order to determine the mechanical characteristics of the steel the rolls are cast, respectively OT-A3, samples were taken at casting, in cylindrical form (fig.2, b), with the next dimensions: diameter d = 60mm and length L = 300mm. The samples were cast in moulds (fig.2, a) painted in heat resisting finish, in order to control the change of the heat charge towards outside, the difference between the rolls and the cast samples being too big. The samples have been taken from three charges, out of which four condensing roll sets have been cast, with different dimensions [7, 8].

a. b.

Figure 2. The moulds and the cast samples to determine the mechanical characteristics

The hardness of the cast samples was determined with the help of Rockwell Durometer, existing in the Heat Treatment Laboratory at the Faculty of Engineering Hundoara. The hardness was determined in scroll, on three generators, situated at 120 degrees between them [7, 8]. The 12 samples, cast in three different charges, are going to be constrained to heat treatments. Taking into account the fact that the diagrams of heat treatment applied to the rolls cast of hypereutectoide steel, Adamite type [5, 6, 7], and diagrams of heat treatment for cast samples, respectively assay-samples obtained out of them were laid down (fig. 3).

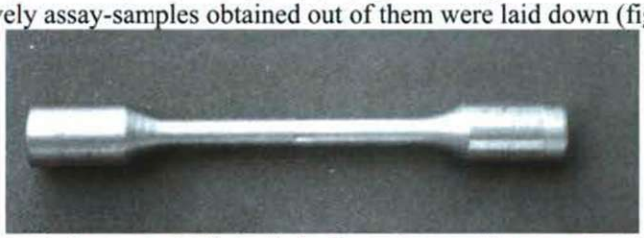
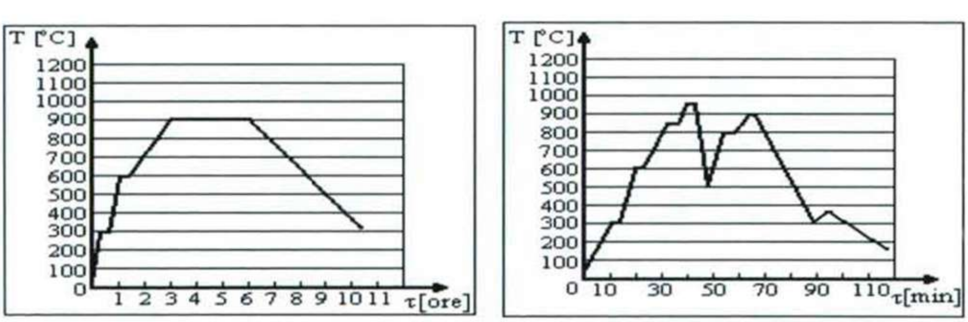


Figure 3. Assay-sample obtained of roll sample, cast of hypereutectoid steel

After manufacturing, the assay-samples were constrained to the secondary heat treatment, which has as purpose the increasing of hardness. The two heat treatments applied to the cast samples, respectively assay-samples obtained out of them, and were executed at the Engineering Faculty of Hunedoara (fig. 4) [5].



a. b.

Figure 4. The thermal treatment applied to the cast sampled of the Adamit type steel: a-primary thermal treatment; b-secondary thermal treatment

3. CONCLUSIONS

In account with the fact that the rolls cast of Adamite type steel, with a high content of carbon and alloyed with Cr,Ni,Mo, used at S.C. Arcelor Mittal S.A. Hunedoara, have won a large dispersion at the medium and small section mill, as well as at the wire mill the determination, on samples, of the mechanical characteristics of this type of alloyed being useful.
For the prominence of the differences recorded for recorded hardness at casting, after the primary heat treatment and after the secondary heat treatment, the bar chart from fig.5 was laid out, which systematise the recorded results, for all the three stages of hardness determination.

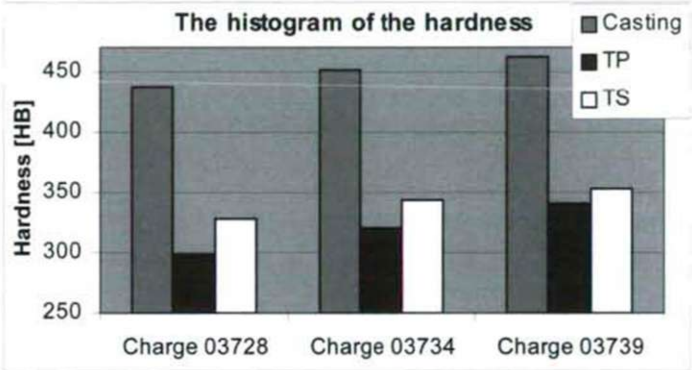


Figure 5. Comparison of hardness recorded (at casting, after primary and secondary heat treatment) in charges case 03728, 03734, 03739

After the performance of the experiments on the three charges it results that [5]:

- the hardness of the cast samples, before the primary heat treatment are situated in the interval 434,2…463,8 HB;
- the medium recorded hardness, after the primary heat treatment, are situated in the interval 298,264…341,247 HB;
- after the processing of the assay-samples and the secondary heat treatment the final hardness were situated in the interval 328,28…353,23 HB;
- the values hardness are situated in the limits provided by the standards in stoutness;

To conclude, we can establish that the hardness obtained at casting, respectively after thermal treatment applied, it is very important because of the fact that it plays a main role in the throttling process, with direct influences on the exploitation hardness.

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